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(54) Pressure sensor assembly.

(57) A self-retaining, self-sealing manifold pressure sensor assembly includes a sensor body (16) with depending stem (18) and an enlarged lower foot (20) on the stem (18). The stem is tightly surrounded by a sealing and retention boot (22), which has a lower flange (30) located just above the stem foot (20) and which is larger than the stem foot (20). The stem foot (20) is smaller than the installation hole (12) in the manifold wall, while the boot flange (30) is larger, but flexible. The sensor (14) is installed by inserting the probe and surrounding boot together through the hole (12), with the flange (30) flexing as it passes through. After installation, the flange (30) is trapped between the stem foot (20) and the wall (10), which prevents expulsion due to positive pressure spikes.

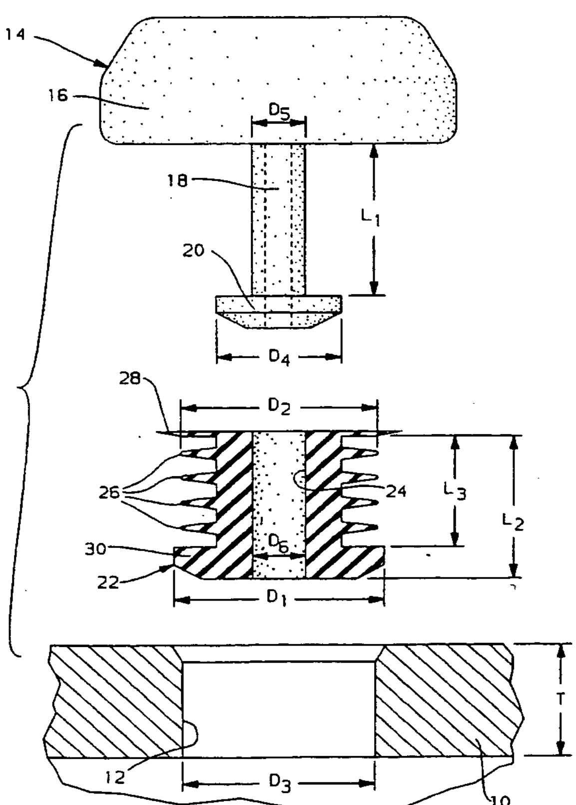

FIG. 1

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This invention relates to a pressure sensor assembly.

As part of a continuing effort to fine tune vehicle engine performance, more and more engine conditions are continually monitored. One of these is manifold pressure, which is generally negative, below ambient pressure, but is subject to rapid positive fluctuations, as in the case of engine back fire. Any pressure sensor must pass through an opening in the manifold wall, which must be sealed. In addition, it must be securely mounted to the manifold wall. Typically, the sealing and installation functions are separate and independent. The sensor probe inserted into the manifold wall is surrounded by a sealing sleeve, while the body of the sensor is retained to the manifold wall by separate fasteners, such as screws. While such an arrangement works well, there would be a cost advantage in eliminating installation steps and parts.

The present invention seeks to provide an improved pressure sensor assembly.

According to an aspect of the present invention, there is provided a pressure sensor assembly as specified in claim 1.

It is possible to provide a sensor assembly which combines sealing and installation functions into one.

In a preferred embodiment, a manifold wall contains a cylindrical installation hole and the sensor consists of a sensor body with a depending cylindrical stem long enough to extend through the installation hole. The outside diameter of the stem is significantly smaller than the installation hole, except for an enlarged circular foot formed at the bottom of the stem. The stem foot is still small enough to fit through the installation hole with clearance, however.

The other component of the assembly of this embodiment is a combined retention and sealing boot moulded from a resilient, flexible material, in a generally cylindrical, sleeve shape. The centre of the boot is a cylindrical passage with a diameter substantially equal to the outside diameter of the stem. The outer surface of the boot preferably includes a series of axially spaced flexible fins, each substantially equal to the diameter of the installation hole. At the bottom of the boot is an enlarged circular flange, which is larger in diameter than the installation hole.

Installation can be a simple, two-step process. Preferably, the sensor body stem is first inserted through the boot central passage, which expands to allow the larger stem foot to pass completely through it. Then, the sensor body and boot are inserted together through the wall installation hole. The boot's lower flange bends back, popping out on the lower side of the hole, trapped between the wall and the stem foot. The stem can thus be tightly sealed to the boot central passage, and the boot ribs can be tightly sealed to the installation hole, so no pressure is lost. Should a rapid pressure rise occur, the trapped flange can prevent the assembly from being blown out.

It is possible with some embodiments to have a very simple structure which nevertheless can eliminate a fair amount of cost in assembly by combining the sealing and retention features in one structure. That is, the sealing boot surrounding the stem can also provide mounting retention by trapping the flexible lower flange between the wall and the foot of the stem.

An embodiment of the present invention is described below, by way of illustration only, with reference to the accompanying drawings, in which:

Figure 1 is an exploded partial cross-sectional view of a manifold wall installation hole, of an embodiment of retention, sealing boot and sensor body;

Figure 2 shows the sealing boot of Figure 1 installed on the sensor body;

Figure 3 shows the sealing boot and sensor body of Figure 1 during installation to the manifold wall;

Figure 4 shows the sealing boot and sensor body of Figure 1 as installed in the manifold wall; and

Figure 5 shows the sealing boot and sensor body of Figure 1 during a rapid pressure rise in the manifold.

Referring to Figure 1, a manifold is represented by a section of manifold wall 10, which has a thickness T. The pressure above wall 10 is the ambient pressure, while the pressure below is manifold pressure. The manifold pressure may vary from the usual negative to infrequent and high, positive spikes, caused for example by an engine backfire. A cylindrical installation hole 12 drilled through wall 10 has a length equal to T, a fixed diameter D_3, and a chamfered upper edge. A sensor body 14 includes a large housing 16 which contains the actual sensor mechanism, and a depending cylindrical stem 18 long enough to extend through hole 12 and ported to transfer pressure to housing 16.

The diameter D_5 of stem 18 is considerably less than the diameter D_3 of the hole 12, but an enlarged circular foot 20 formed integrally at the bottom of stem 18 has a diameter D_4 which is larger than diameter D_5 but smaller than diameter D_3. Foot 20 also has a chamfered lower edge. The length between the top of foot 20 and the base of housing 16 is indicated at L_1, and is substantially greater than T.

A combined retention and sealing boot 22 is generally sleeve-shaped, moulded from a resilient flexible material such as a fluoro silicon polymer,

which is also durable and heat resistant. A central cylindrical passage 24 has a diameter D_6 which is close to, or very slightly less than diameter D_5 of stem 18 and has a total length L_2 substantially equal to L_1. The outside of boot 22 has a series of four substantially identical, axially spaced annular fins 26, each of which has an edge diameter D_2 substantially equal to or just slightly greater than diameter D_3 of hole 12. A larger top fin 28, in the embodiment disclosed, has a diameter significantly larger than diameter D_3. At the bottom of boot 22 is an enlarged flange 30, thicker than the fins 26, and having a diameter D_1 larger than diameter D_3. Like foot 20, flange 30 has a chamfered lower edge. The inside length L_3 from the top of flange 30 to the top fin 28, is substantially equal to T.

Referring to Figures 2 to 4, the operation and interaction of the various elements described above lead to a simplified installation process. Initially, the sensor body 14 is assembled to the boot 22 by inserting stem 18 through central passage 24. This is possible because of the resilience and elasticity of the material from which boot 22 is moulded, which will expand to allow foot 20 to pass therethrough, and is aided somewhat by the chamfered lower edge of foot 20. The central boot passage 24 retracts to seal tightly against the outer surface of stem 18. When complete, as shown in Figure 2, a subassembly of the two components is created, and boot 22 is securely trapped between foot 20 and sensor body 14, given the relationship between lengths L_1 and L_2.

Next, as shown in Figure 3, the subassembly is inserted into installation hole 12, aided by the chamfered edges of hole 12 and boot flange 30. Flange 30, being larger in diameter, is compressed somewhat, and flexes axially up (in the view in Figure 3) as it passes through hole 12. Foot 20 clears hole 12 completely. The fins 26 are also flexed axially up slightly, but pass through with much less resistance than flange 30. Finally, as shown in Figure 4, flange 30 pops out below wall 10.

Referring to Figure 4, the normal operation after installation is illustrated. Pressure can enter housing 16 through the ported stem 18, but leakage is prevented. There is no leak path between stem 18 and boot central passage 24 because of the relation between diameters D_5 and D_6. Likewise, there is no leak path between the outside of boot 22 and hole 12, because of the relation between diameters D_2 and D_3.

In normal operation, retention is not a problem. Sensor body housing 16 is much larger than hole 12 and the manifold pressure below wall 10 is generally negative, tending to pull both housing 16 and boot 22 down (in the views of Figures 4 and 5), as is illustrated by the axial clearances between the underside of wall 10, boot flange 30, and stem foot 20. The larger top fin 28 helps to cushion sensor housing 16 from direct abutment with the upper side of wall 10.

Referring to Figure 5, high positive pressure, from for example an engine backfire, would tend to expel boot 22 and sensor body 14. However, the trapping of flange 30 between foot 20 and the underside of wall 10 prevents such expulsion. Flange 30 does not flex down to allow it to exit hole 12 as easily as it flexed up to enter hole 12. This selective inflexibility is partially a result of upper surface of flange 30, which abuts the underside of wall 10 around hole 12, not being chamfered. Even more so, this selective inflexibility is due to the cooperative support that flange 30 receives from the upper surface of stem foot 20, which is pushed into it by the positive pressure in the manifold. Therefore, flange 30 will not be expelled through hole 12 nearly so easily as it was inserted in the first place. Furthermore, the squeezing of flange 30 between the upper side of foot 20 and the under side of wall 10, illustrated in Figure 4, serves as an additional seal, aiding the sealing provided by the fins 26 and blocking off the boot passage 24 even more securely. Thus, not only is expulsion substantially prevented, but additional sealing is provided in response to any positive pressure spike.

Variations in the preferred embodiment could be made. For example, the outer surface of the boot 22 could simply be cylindrical and smooth, without the fins 26, so long as its outer diameter was similar to the outer diameter of fins 26. However, the fins 26 make installation easier because of their axial flexibility and because of the axial clearance they leave relative to the lower boot flange 30, improving its axial flexibility during insertion. Boot 22 could be moulded or otherwise integrally formed around the pressure sensor stem 18, starting out in the condition shown in Figure 2 and eliminating the installation step of inserting foot 20 through central passage 24.

The disclosures in United States patent application no. 912,379, from which this application claims priority, and in the abstract accompanying this application are incorporated herein by reference.

Claims

1. A pressure sensor assembly for installation through an aperture in a wall of a device separating an enclosed pressure within the device from ambient pressure, pressure in the device being subject to fluctuate above ambient pressure, tending to expel the sensor assembly from the aperture; the sensor assembly (14) comprising a sensor including a sensor body

(16), a stem (18) depending from the sensor body and an enlarged foot (20) at an end of the stem remote from the sensor body, the foot having a diameter smaller than the diameter of the aperture into which the sensor is adapted to be installed; and a retention and sealing member (22) of flexible material including a base (24) for receiving in sealing manner the stem of the sensor and including a sealing surface (26) having a diameter substantially equal to the diameter of the aperture into which the sensor is adapted to be installed and an enlarged flange with a diameter larger than the diameter of the aperture into which the sensor is adapted to be installed; the sensor body and retention and sealing member being installable in the wall simultaneously, the enlarged flange being flexible to pass through the aperture, the stem and aperture being sealable against pressure loss by sealing engagement with the member, the sensor body being retainable in the wall by trapping of the enlarged flange between the wall and the enlarged foot of the sensor.

2. A pressure sensor assembly according to claim 1, wherein the stem (18) of the sensor assembly (14) has a generally cylindrical outer surface and the retention and sealing member (22) includes a generally cylindrical central passage with a diameter substantially equal to the diameter of the outer surface of the stem; the retention and sealing member being installable on the stem in a tight fitting sealing manner.

3. A pressure sensor assembly according to claim 1 or 2, wherein the retention and sealing member (22) includes a plurality of axially spaced annular sealing rings (26).

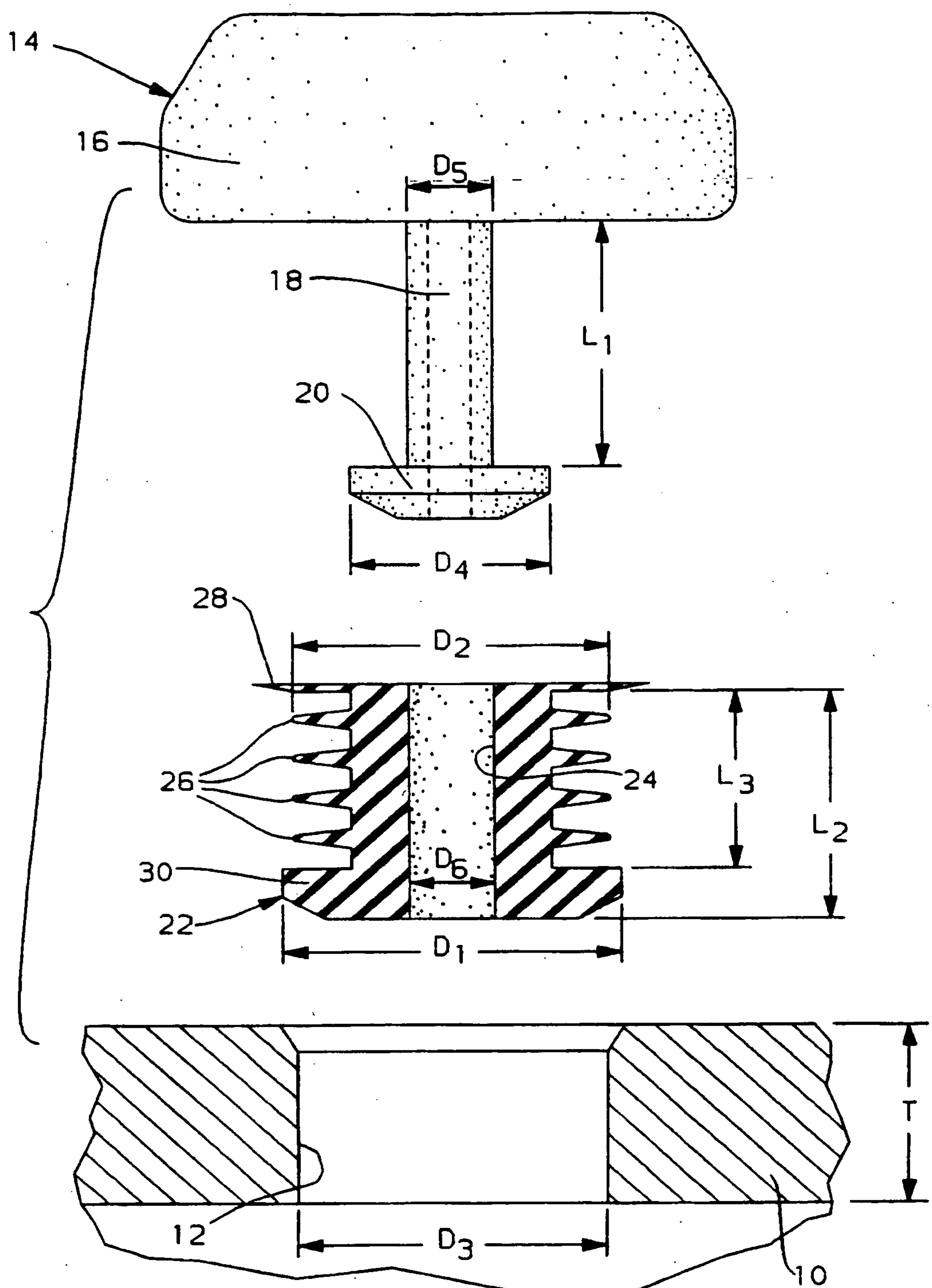

FIG. 1

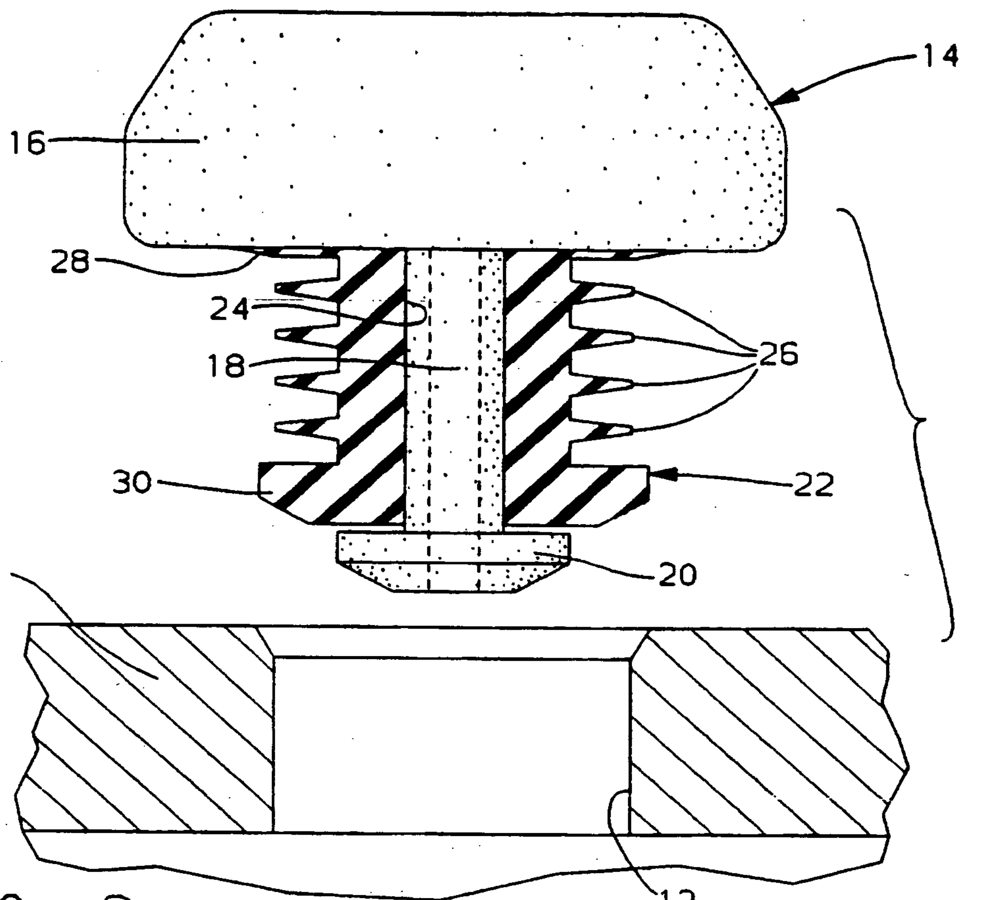

FIG. 2

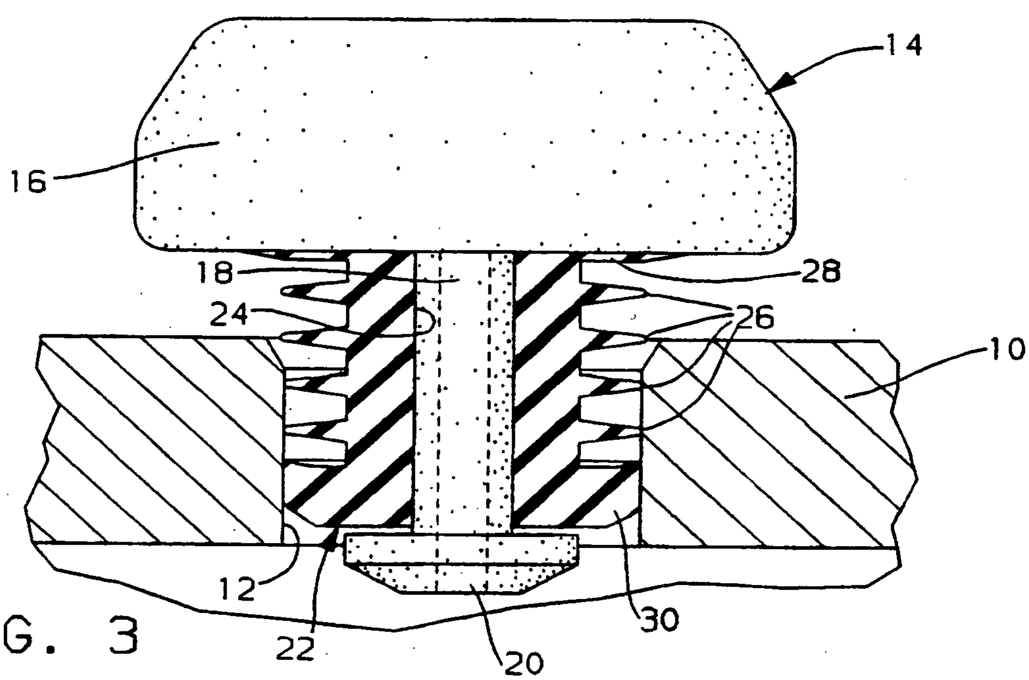

FIG. 3

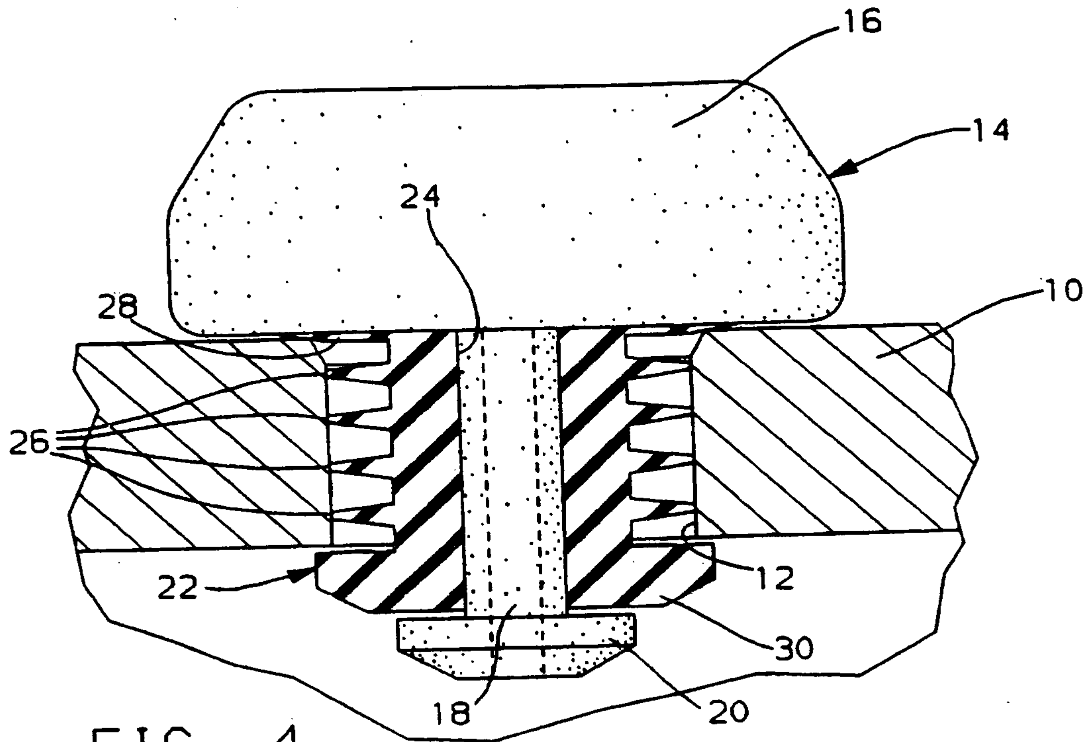

FIG. 4

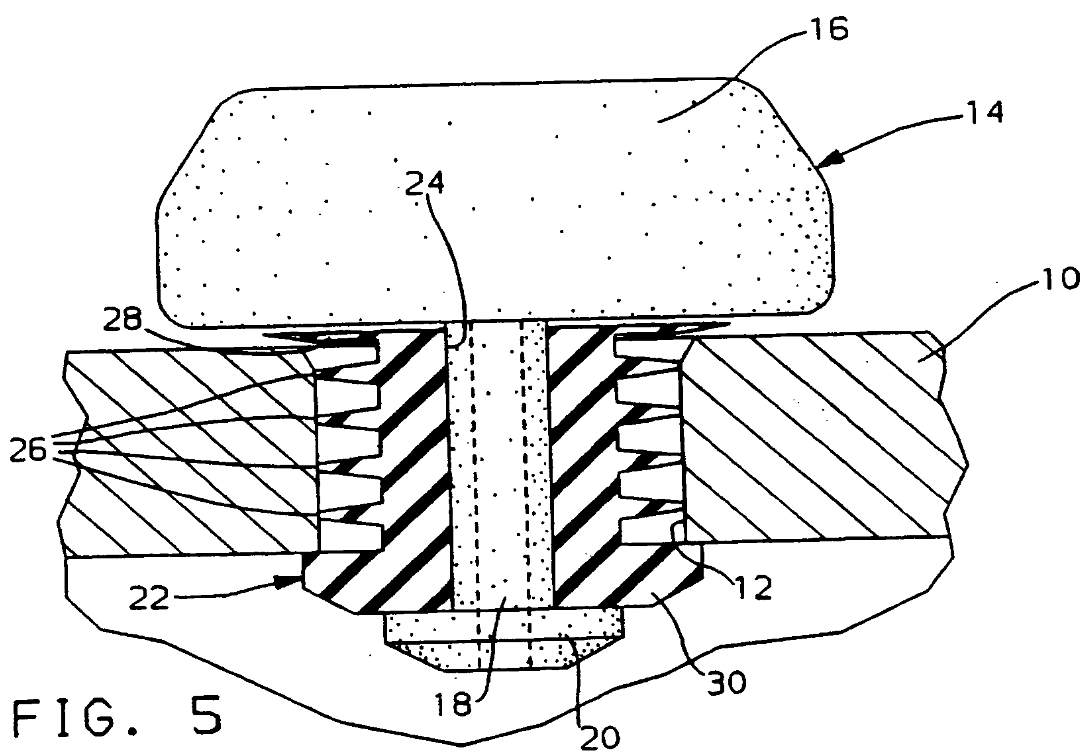

FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 93 20 1890

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
A	WO-A-81 03678 (ROSEMOUNT INC.) * page 5, line 6 - line 24; figures 2,3 * -----	1-3	G01L19/00

TECHNICAL FIELDS SEARCHED (Int.Cl.5)
G01L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	5 November 1993	MUCS, A

CATEGORY OF CITED DOCUMENTS

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